



Collection Math Study Guide

Kentucky Division of Compliance Assistance
Certification and Licensing Branch

This study guide is intended to help students become more familiar with the variety of math equations within the Collection manual and exam.

Below is a chart of where math can be found in the training manual.

Chapter	Name	Page	Concept
2	Mapping	14	Scale
3	Biology	24	Population Equivalents (not on formula sheet)
4	Collection Systems	31	Area/Velocity/Flow
4	Collection Systems	34	Slope and Grade
4	Collection Systems	36	Volume and conversions
4	Collection Systems	42	Detention Time/Flushing time
4	Collection Systems	55	$Q = A \times V$
5	Pipes	71	Volume and conversions
6	Pumps	84	Time to pump out/Fill a tank (p.104)
6	Pumps	85	HP and KW/hr
6	Pumps	90	Time to fill bar screen
6	Pumps	100	Lbs formula
6	Pumps	110	Costs of operation
7	I & I	138	% I & I
11	Operations and Rehabilitation	188	Various cost problems

Work through each problem introduced in each chapter and the math questions (if any) at the end of each chapter.

Class I & II

1. A pump station has been averaging a screenings removal of 1.8 ft^3 per million gallons. The average daily flow is 3.2 MGD. How many days will it take to fill a screen with a 200 ft^3 capacity?
 - A. 25 days
 - B. 35 days
 - C. 40 days
 - D. 45 days

2. A float is placed in a manhole. If the float travels 460 feet in 3 min 45 seconds. What is the estimated velocity in the channel in ft/sec?
 - A. 0.5 ft/sec
 - B. 1 ft/sec
 - C. 1.5 ft/sec
 - D. 2 ft/sec

3. Wastewater is pumped into a 8 inch line by a 200 gpm rated pump that is 85% efficient. What is the velocity of the wastewater in the line?
 - A. 1.1 ft/sec
 - B. 1.6 ft/sec
 - C. 2.0 ft/sec
 - D. 2.4 ft/sec

4. What is the chlorine feed rate per hour for a flow of 2.3 MGD with a dose rate of 25 mg/L?
 - A. 20 lbs
 - B. 48 lbs
 - C. 160 lbs
 - D. 480 lbs

5. If it is assumed that the average velocity of wastewater in the collection system is 2.1 feet per second, approximately, how long would it take the wastewater to reach a treatment plant from the furthest point in the system if the distance from the treatment plant to the farthest lateral is 8 miles?

- A. 2 hrs
- B. 4 hrs
- C. 6 hrs
- D. 8 hrs

6. How many pounds of TSS are received in the collection system daily, if the system flow is 56,000 gpd and the TSS concentration is 210 mg/L?

- A. 9.8 lbs
- B. 98 lbs
- C. 980 lbs
- D. 196 lbs

7. If two 125 gpm pumps are used, how long will it take to empty a rectangular tank 45 feet long by 22 feet wide containing 15 ft of water?

- A. 30 minutes
- B. 7.4 hrs
- C. 29.6 hrs
- D. 119 hrs

8. Estimate the population served if a treatment plant is processing 0.85 MGD and an average of 100 gallons per person is assumed.

- A. 85 people
- B. 120 people
- C. 850 people
- D. 8500 people

9. The flow entering the leg of a tee connection is $9 \text{ ft}^3/\text{sec}$. If the flow through one branch of the tee is $5 \text{ ft}^3/\text{sec}$, what is the flow through the other branch in gpm?

- A. 808 gpm
- B. 1795 gpm
- C. 2244 gpm
- D. 4039 gpm

10. What is the capacity of a wet well if a pump, rated at 75 gpm, requires 1 hour and 35 minutes to empty the station? Assume no inflow.

- A. 952.5 ft^3
- B. 7125 ft^3
- C. 53295 ft^3
- D. 757 ft^3

11. A 2 feet wide by 4 ft high rectangular channel has water flowing in it to a depth of 18 inches, and has an average velocity of 5 f/s.

What is the approximate flow rate?

- A. $15 \text{ ft}^3/\text{sec}$
- B. $30 \text{ ft}^3/\text{sec}$
- C. $40 \text{ ft}^3/\text{sec}$
- D. $60 \text{ ft}^3/\text{sec}$

12. During construction of a pipeline that has a 2,350 foot run of 6 inch PVC pipe. The pipe is supplied in 20 foot sections. How many sections of pipe will be needed to complete the run without having excess pipe on hand?

- A. 110
- B. 118
- C. 125
- D. 130

13 What is the grade that has a 3 foot rise in 450 feet?

- A. 0.15% grade.
- B. 0.3% grade.
- C. 0.45% grade.
- D. 0.66% grade.

14. A lift station is 10 feet by 15 feet and a depth of 40 feet. If the depth of water is now is at 18 feet. How many additional gallons can the lift station hold before it overflows?

- A. 20,196 gallons
- B. 24,684 gallons
- C. 44,880 gallons
- D. 65,076 gallons

15. Chlorine is used in the system for "freshening". If the chlorine demand is 6.3 mg/L and the desired residual is 1.6 mg/L. The flow through the system is 7.6 MGD. How many pound of chlorine are to be used a day?

- A. 21 lbs
- B. 102 lbs
- C. 400 lbs
- D. 500 lbs

16. A 22 feet deep lift station has a diameter of 13 feet, the influent flow causes the water level to rise 4.5 ft in 16 minutes. With pump one running to empty the lift station the water level rises 3 foot in 16 minutes. What is the pump rate of the pump in gpm? The pump rate is equal to the influent rate minus the rise rate.

- A. 93 gpm
- B. 186 gpm
- C. 280 gpm
- D. 1,488 gpm

17. What is the capacity of a wet well if the pump, rated at $0.5 \text{ ft}^3/\text{s}$, requires 2 hours 20 minutes to empty the station? Assume no other inflow or outflow.

- A. 4,200 gallons
- B. 31,416 gallons
- C. 42,000 gallons
- D. 63,360 gallons

18. A new manhole has been installed 450 feet from an existing manhole. How far would this new manhole be located from the old one on a map with a scale of 1 inch equals 50 feet?

- A. 6 inches
- B. 8 inches
- C. 9 inches
- D. 10 inches

19. If the average lbs of TSS in the influent per month was 2100 lbs/day and the average daily flow was 875,000 gpd what would be the average TSS concentration coming into the plant per day?

- A. 36 mg/L
- B. 71 mg/L
- C. 143 mg/L
- D. 287 mg/L

20. During a survey the elevation of upper pipe was 35 ft above sea level. The slope over a run of 1500 ft was calculated to be 2%. What would be elevation of the lower pipe?

- A. 5 ft
- B. 30 ft
- C. 40 ft
- D. 65 ft

Bonus question

21. You have lost your tape measure and you have to determine the diameter of an old sewer pipe to find the best match for replacement. You measure the flow, with a rubber duck and a stopwatch as 3 ft/sec. Using a 5 gallon bucket you have determined the flow to be 600 gpm (you have a lot of buckets). What is the best estimate of the diameter of the pipe?

- A. 6 inches
- B. 8 inches
- C. 9 inches
- D. 10 inches

Answer Key

- | | |
|-------|-------|
| 1. B | 11. A |
| 2. D | 12. B |
| 3. A | 13. D |
| 4. A | 14. B |
| 5. C | 15. D |
| 6. B | 16. A |
| 7. B | 17. B |
| 8. D | 18. C |
| 9. B | 19. D |
| 10. A | 20. A |
| | 21. C |

Class III & IV

22. The interior of a 12 inch pipe is uniformly coated with a $\frac{1}{2}$ inch thick layer of FOG. If the velocity of water flowing through this pipe was calculated at 2.4 ft/s, what would be the flow in gpm in the FOG coated pipe?

- A. 448.8 gpm
- B. 709 gpm
- C. 775.5 gpm
- D. 845.5 gpm

23. What is the detention time in an interceptor sewer 1 and $\frac{1}{3}$ of a mile long and 36 inches in diameter if the average flow is 0.9 MGD?

- A. 4.6 hrs
- B. 7.2 hrs
- C. 9.88 hrs
- D. 11.5 hrs

24. Two 65 hp pumps operate a lift station. The lift station run 16 hours per day. The power in this municipality is charged at a rate of 15 cents per kWhr. What is the cost per day for running the pumps?

- A. \$131.85
- B. \$158.87
- C. \$210.75
- D. \$232.75

25. The invert elevations for a sewer line at adjacent manholes is 475 feet apart are 215.5 ft and 209.8 ft. What is the percent slope or grade of this section of line?

- A. 1.2%
- B. 1.5%
- C. 2.0%
- D. 2.5%

26. Your town has been receiving complaints about odors in your sewer system. To correct the problem, you have been instructed to use chlorine for odor control. The recommended feed concentration is 9 mg/L and your daily flow is 55 gpm. How much must you budget per year for chlorine if the cost is \$1.01 per pound?

- A. \$218.6
- B. \$2,186
- C. \$1,521.8
- D. \$450.66

27. The wet well at a lift station receives a flow of 260 gpm. The wet well is 12 ft by 15 feet. How many minutes will it take to raise the water level 4 ft 6 inches in the wet well?

- A. 2.34 min
- B. 5.3 min
- C. 23.3 min
- D. 30 min

28. The distance between two manholes on a map is measured as $\frac{9}{16}$ of an inch. Scale for the map is 1 inch equals 100 feet. What is the actual distance between the manholes?

- A. 16.75 ft
- B. 45.5 ft
- C. 56.25 ft
- D. 61.3 ft

29. The average flow to your facility is 7.2 MGD. When you receive a 4 inch rain your flow increases to 11.6 MGD. What is the percentage of inflow and infiltration?

- A. 62%
- B. 161%
- C. 201%
- D. 261%

30. If the slope of a sewer pipe is 0.5% for a length of 1,000 feet and then changes to 0.25% for an additional 1,600 feet. If the elevation of the upper end of the pipe was 250 ft what would be the elevation of the pipe at the end of the pipe run?

- A. 241 ft
- B. 245.5 ft
- C. 250 ft
- D. 259 ft

31. You have three lift stations. #1 has a 8 hp motor and runs for 20 minutes per hour. #2 has a 14 hp pump and it runs 40 minutes per hour. #3 has a 26 hp pump that runs 50 minutes every 2 hours. What is the yearly electrical cost to operate these three stations if each kilowatt hour cost \$0.09?

- A. \$4,401
- B. \$4,705
- C. \$10,017
- D. \$13,428

32. A plant has an average daily flow of 1.25 MGD with an average daily influent BOD of 270 mg/L. If this facility removes 88% of the BOD, how many pounds of BOD are removed in a non-leap year?

- A. 2,814 lbs
- B. 90,409 lbs
- C. 123,260 lbs
- D. 904,098 lbs

33. Chlorine is being fed at two lift stations for odor control. At LS #1, 7 mg/l are being fed to a flow of 800,000 GPD and at LS # 2, 8.9 mg/l is being fed to a flow of 1.3 MGD. The cost of chlorine is \$0.75 per pound. What is the yearly cost of chlorine for these two lift stations?

- A. \$12,784
- B. \$13,632
- C. \$26,417
- D. \$39,201

34. In a 18 foot diameter wet well, with no pumps running, the water level rose 6 feet in 24 minutes. When one pump is in operation the water level rose 18 inches in the same time. What is the pump rate in gallons per minute?

- A. 356 gpm
- B. 454 gpm
- C. 475 gpm
- D. 594.5 gpm

35. If the daily flow going to the treatment plant is 8.6 MGD, what is the velocity in ft/sec through a 30-inch main carrying the effluent?

- A. 2.1 f/s
- B. 2.7 ft/s
- C. 1.75 f/s
- D. 4.1 f/s

There are a number of construction cost problems in the level III and IV exams. For examples of what you might be asked refer to pages 196 -202 and 214 -216 in the Collection manual.

Answer Key

- | | |
|-------|-------|
| 22. B | 29. B |
| 23. C | 30. A |
| 24. D | 31. D |
| 25. A | 32. D |
| 26. B | 33. D |
| 27. C | 34. A |
| 28. C | 35. B |



Questions or Concerns?

The Kentucky Operator Certification Program provides training and issues certifications to ensure that individuals engaged in performing many of Kentucky's critical environmental activities are qualified and capable to perform their duties. DCA staff are available to provide on-site assistance and training.

Online: eec.ky.gov

Phone: 502-782-6189

E-mail: envhelp@ky.gov



Kentucky Division of Compliance Assistance

Certification and Licensing Branch

300 Sower Boulevard, 1st Floor, Frankfort, KY 40601

Assistance Hotline: envhelp@ky.gov | 502-782-6189